

## CLAIMS:

1. A fingerprint authentication method (20) for a user fingerprint image (UFI) based on a plurality of control fingerprint images (CFI), the method comprising:
  - (S24) transforming each control fingerprint images (CFI) into a transformed control fingerprint image (TCFI) as a function of a pressure map (PM) associated with the user fingerprint image (UFI);
  - (S26) matching each transformed control fingerprint image (TCFI) to the user fingerprint image (UFI); and
  - (S28) authenticating a first transformed control fingerprint image (TCFI) having a best match with the user fingerprint image (UFI) as an identified fingerprint image (IFI).
2. The fingerprint authentication method (20) of claim 1, further comprising:
  - (S22) deriving the user fingerprint image (UFI) from the pressure map (PM), wherein the user fingerprint image (UFI) is a black and white fingerprint image.
3. The fingerprint authentication method (20) of claim 1, further comprising:
  - (S22) deriving the user fingerprint image (UFI) from the pressure map (PM), wherein the user fingerprint image (UFI) is a grayscale fingerprint image.
4. The fingerprint authentication method (20) of claim 1, wherein (S24) transforming each two control fingerprint image (CFI) into a transformed control fingerprint image (TCI) as a function of the pressure map (PM) associated with the user fingerprint image (UFI) includes:
  - (S62) computing at least one control point within a first control fingerprint image (CFI) to yield a control point fingerprint image (CPFI);
  - (S64) superimposing the at least one control point onto the pressure map (PM); and
  - (S66) computing pixel intensities and directions around a neighborhood of the at least one control point from the pressure map.
5. The fingerprint identification method (20) of claim 4, wherein (S24) transforming each two control fingerprint image (CFI) into a transformed control fingerprint image

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(TC1) as a function of the pressure map (PM) associated with the user fingerprint image (UFI) further includes:

(S68) mapping the pixel intensities and corresponding control point distances for matching, to a greatest extent possible, the first control fingerprint image (CF1) into the user fingerprint image (UFI); and

(S70) warping the first control fingerprint image (CF1) based on the mapped pixel intensities and control point distances to thereby yield the first transformed control fingerprint image (TCFI).

6. The fingerprint authentication method (20) of claim 1, wherein (S24) transforming each two control fingerprint image (CFI) into a transformed control fingerprint image (TC1) as a function of the pressure map (PM) associated with the user fingerprint image (UFI) includes:

(S62) computing at least one control point within a first control fingerprint image (CFI) to yield a control point fingerprint image (CPFI);

(S64) superimposing the pressure map (PM) onto the at least one control point; and

(S66) computing pixel intensities and directions around a neighborhood of the at least one control point from the pressure map.

7. The fingerprint identification method (20) of claim 6, wherein (S24) transforming each two control fingerprint image (CFI) into a transformed control fingerprint image (TC1) as a function of the pressure map (PM) associated with the user fingerprint image (UFI) further includes:

(S68) mapping the pixel intensities and corresponding control point distances for matching, to a greatest extent possible, the first control fingerprint image (CF1) into the user fingerprint image (UFI); and

(S70) warping the first control fingerprint image (CF1) based on the mapped pixel intensities and control point distances to thereby yield the first transformed control fingerprint image (TCFI).

8. The fingerprint identification method (20) of claim 1, wherein (S26) matching each transformed control fingerprint image (TCFI) to the user fingerprint image (UFI) includes:

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computing a matching score of each transformed control fingerprint image (TCFI) to the user fingerprint image (UFI).

9. The fingerprint identification method (20) of claim 1, wherein (S28) authenticating the first transformed control fingerprint image (TCFI) having the best match with the user fingerprint image (UFI) as an identified fingerprint image (IFI) includes:

selecting the first transformed control fingerprint image (TCFI) based on the first transformed control fingerprint image (TCFI) having a highest matching score among all of the matching scores.

10. A fingerprint authentication module (80) for a user fingerprint image (UFI) based on a plurality of control fingerprint images (CFI), comprising:

means (81-83) for transforming each control fingerprint images (CFI) into a transformed control fingerprint image (TCFI) as a function of a pressure map (PM) associated with the user fingerprint image (UFI);

means (81-83) for matching each transformed control fingerprint image (TCFI) to the user fingerprint image (UFI); and

means (81-83) for authenticating a first transformed control fingerprint image (TCFI) having a best match with the user fingerprint image (UFI) as an identified fingerprint image (IFI).

11. The fingerprint identification device (80) of claim 10, further comprising:

means (81-83) for deriving the user fingerprint image (UFI) from the pressure map (PM), wherein the user fingerprint image (UFI) is a black and white fingerprint image.

12. The fingerprint identification device (80) of claim 10, further comprising:

means (81-83) for deriving the user fingerprint image (UFI) from the pressure map (PM), wherein the user fingerprint image (UFI) is a grayscale fingerprint image.

13. A fingerprint authentication system, comprising:

a database (50) operable to store a plurality of control fingerprint images (CFI);

and

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a fingerprint module (41 and 80) operable to retrieve the plurality of control fingerprint images (CFI) from the database (50) to thereby authenticate one of the control fingerprint images (CFI) with a user fingerprint image (UFI),

wherein the fingerprint module (41 and 80) is further operable to transform each control fingerprint images (CFI) into a transformed control fingerprint image (TCFI) as a function of a pressure map (PM) associated with the user fingerprint image (UFI);

wherein the fingerprint module (41 and 80) is further operable to match each transformed control fingerprint image (TCFI) to the user fingerprint image (UFI); and

wherein the fingerprint module (41 and 80) is further operable to authenticate a first transformed control fingerprint image (TCFI) having a best match with the user fingerprint image (UFI) as an identified fingerprint image (IFI).

14. The fingerprint authentication system of claim 13, wherein the fingerprint module (41 and 80) is further operable to derive the user fingerprint image (UFI) from the pressure map (PM), wherein the user fingerprint image (UFI) is a black and white fingerprint image.

15. The fingerprint authentication system of claim 13, wherein the fingerprint module (41 and 80) is further operable to derive the user fingerprint image (UFI) from the pressure map (PM), wherein the user fingerprint image (UFI) is a grayscale fingerprint image.

16. The fingerprint authentication system of claim 13, wherein, during the transforming of each two control fingerprint image (CFI) into a transformed control fingerprint image (TC1) as a function of the pressure map (PM) associated with the user fingerprint image (UFI), the fingerprint module (41 and 80) is further operable to compute at least one control point within a first control fingerprint image (CFI) to yield a control point fingerprint image (CPFI), to superimpose the at least one control point onto the pressure map (PM), and to compute pixel intensities and directions around a neighborhood of the at least one control point from the pressure map.

17. The fingerprint identification system of claim 16, during the transforming of each two control fingerprint image (CFI) into a transformed control fingerprint image (TC1) as a function of the pressure map (PM) associated with the user fingerprint image (UFI), the fingerprint module (41 and 80) further operable to map the pixel intensities and

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corresponding control point distances for matching, to a greatest extent possible, the first control fingerprint image (CF1) into the user fingerprint image (UFI), and to warp the first control fingerprint image (CF1) based on the mapped pixel intensities and control point distances to thereby yield the first transformed control fingerprint image (TCFI).

18. The fingerprint authentication system of claim 13, wherein, during the transforming of each two control fingerprint image (CFI) into a transformed control fingerprint image (TC1) as a function of the pressure map (PM) associated with the user fingerprint image (UFI), the fingerprint module (41 and 80) further operable to compute at least one control point within a first control fingerprint image (CFI) to yield a control point fingerprint image (CPFI), to superimpose the pressure map onto the at least one control point, and to compute pixel intensities and directions around a neighborhood of the at least one control point from the pressure map.

19. The fingerprint identification system of claim 18, during the transforming of each two control fingerprint image (CFI) into a transformed control fingerprint image (TC1) as a function of the pressure map (PM) associated with the user fingerprint image (UFI), the fingerprint module (41 and 80) further operable to map the pixel intensities and corresponding control point distances for matching, to a greatest extent possible, the first control fingerprint image (CF1) into the user fingerprint image (UFI), and to warp the first control fingerprint image (CF1) based on the mapped pixel intensities and control point distances to thereby yield the first transformed control fingerprint image (TCFI).

20. The fingerprint identification system of claim 13, wherein, during the matching of each transformed control fingerprint image (TCFI) to the user fingerprint image (UFI), the fingerprint module (41 and 80) further operable to compute a matching score of each transformed control fingerprint image (TCFI) to the user fingerprint image (UFI).

21. The fingerprint identification system of claim 13, wherein, during the authenticating of the first transformed control fingerprint image (TCFI) having the best match with the user fingerprint image (UFI) as an identified fingerprint image (IFI), the fingerprint module (41 and 80) is further operable to select the first transformed control

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fingerprint image (TCFI) based on the first transformed control fingerprint image (TCFI) having a highest matching score among all of the matching scores.